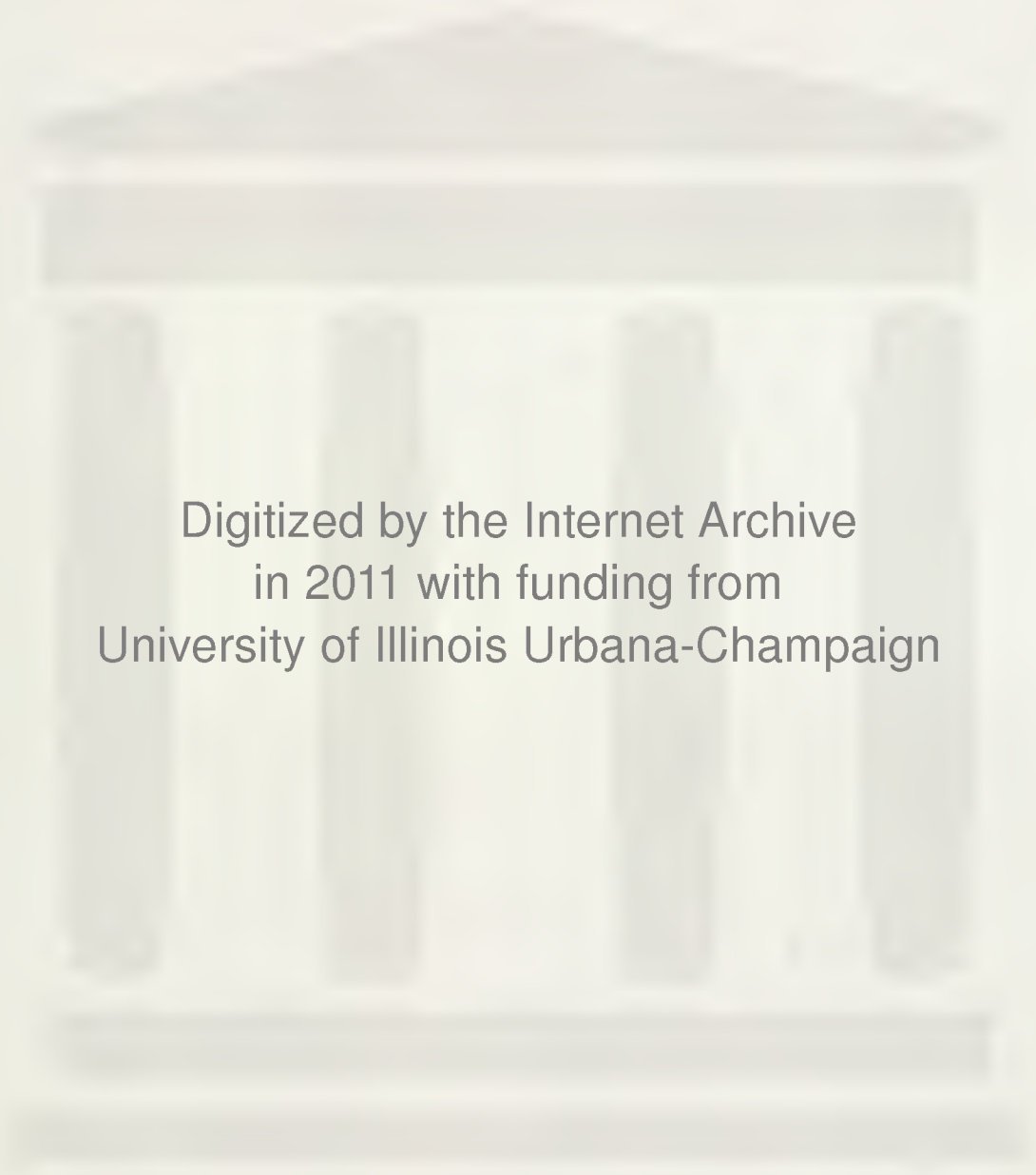

Faculty Working Papers

TAXATION AND THE ALLOCATION OF NON-MARKET TIME

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#683

College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

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June 25, 1980

DRAFT: NOT FOR QUOTATION
COMMENTS INVITED

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Summary

This study explores the impact of income taxation on the allocation of non-market time by households. Using data from the Michigan Survey of Income Dynamics for 1976, a home production equation is estimated for husbands and wives. The results of the study suggest that one effect of taxation is to encourage the home production activity of wives and discourage that of husbands. The implications of this finding for tax policy are discussed.

TAXATION AND THE ALLOCATION OF NON-MARKET TIME

The purpose of this study is to measure the influence of the individual income tax on the allocation of time to non-market activities. The focus of this study is on the home production activities of households, specifically housework and child care. A model of household time allocation is developed and estimated using data from the Michigan Survey of Income Dynamics for 1976. The important influences on the allocation of time are identified and the hypothesis that income taxation affects non-market activity is tested. It is found that taxation tends to encourage the home production activity of wives but tends to discourage the home production activity of husbands.

This study is a departure from the earlier work in the area of home production behavior of households. One of the earliest studies in the area was by Reid (1934) who carefully tabulated hours devoted to non-market work by economic and demographic characteristics. She found income, family size and composition, and location of residence to be important determinants of home production. More recently, Leibowitz (1974) applied econometric techniques to study the influences on time spent in home production. She found that the number and ages of children are important influences on time spent in home production, but that productivity factors such as education have a minimal effect.

Recently, economists have become interested in the influences of the price of time on the allocation of time within the household to non-market activities. Using data from the 1964 National Study of Work and Planning, Bloch (1973) estimated home production functions for husbands and wives. He found that hours devoted to home production vary inversely

with the wage rate and positively with the number of children. In a more recent study, Wales and Woodland (1977) estimated a set of home production and labor supply functions using a maximum likelihood simultaneous equation approach. They found that the wage rate was not a significant determinant of hours of housework.

A common problem that arises in the estimation of home production models is that the wage rate of persons with zero hours of market work is not observed. This generally leads to biased estimates of the home production function. A typical approach is the one taken by Bloch (1973) and involves estimating the wage rate over the employed persons in the sample and imputing the wage according to the personal characteristics of the rest of the sample. It is well-known that this approach leads to downward bias in the estimates of the wage coefficient. Another approach, which was adopted by Wales and Woodland (1977), is to exclude observations on persons whose wages are unobserved. However, this approach admits the possibility of censoring bias.

This study adopts an approach developed by Heckman (1976, 1979) for dealing with the problem of the unobserved wage. Heckman's procedure is a two-stage procedure which corrects for the bias introduced by censoring the sample. This technique has been used successfully in different contexts by Lee (1978), Fligstein and Wolf (1978), and others.

In section I, a theoretical model is developed and hypotheses derived regarding the expected impact of taxation on home production activity. In section II, the problems of estimation are discussed and in section III, the results of the estimation are presented. Section IV contains a discussion of the implications of the findings for tax policy and section V summarizes the findings.

I. Theoretical Expectations

In order to assess the expected effect of taxation on the allocation of time to home production, a simple model is developed based on the assumption of utility maximization subject to constraint. Utility is assumed to be a positive function of family income, Y, and a negative function of hours of labor, L, and hours of home production, N. The utility function takes the form:

$$U = U(Y,L,N)$$

and is assumed to be twice continuously differentiable and convex. The first partial derivatives of the function with respect to income, labor, and home production are U_Y, U_L, and U_N and are positive, negative, and negative, respectively.

Utility is maximized subject to an income constraint and a time constraint. The income constraint may be stated as follows:

$$Y = wL + rN + V - T$$

where w is the wage rate for market work, r is the rate of return on home production, V is the non-work income of the individual (and may include the wage income of other family members), and T is the family's income tax obligation. The income tax is assumed to apply with a marginal rate, t, to work and property income but not to the imputed return on home production.

The individual is also constrained by the total amount of time available. The time constraint states that the total time available, k, is fully exhausted in market work and home production activities:

$$k = L + N.$$

Other uses of time such as charitable work, education, and recreation are assumed exogenous to the model.

Each individual must choose the number of hours of home production which maximizes his or her utility subject to the income and time constraints. Formally, the choice problem is

$$\underset{N}{\text{Max}}\ U(w(k - N) + rN + V - T,\ k - N,\ N).$$

Differentiating with respect to hours of home production yields the first and second order conditions for utility maximization:

$$(1)\quad [r - w(1-t)]U_Y - U_L + U_N = 0$$

$$(2)\quad M = \delta^2 U_{YY} - \delta U_{YL} + \delta U_{YN} - \delta U_{LY} + U_{LL} - U_{LN} + \delta U_{NY} - U_{NL} + U_{NN} < 0$$

where t is the marginal rate of income tax, δ is equal to $[r - w(1-t)]$, and U_{ij} is the second partial derivative of the utility function with respect to i and j, i, j = Y, L, N.

The effect of changes in non-work income, V, on hours of home production may be derived by differentiating (1) with respect to V, substituting for M from (2), and solving for the partial derivative of home production with respect to non-work income. This yields:

$$(3)\quad \frac{\partial N}{\partial t} = -\frac{(1-t)\delta U_{YY}}{M} + \frac{(1-t)(U_{LY} - U_{NY})}{M}$$

which cannot be signed at this level of generality.

The effect of an increase in the rate of income taxation on home production is likewise indeterminate. Differentiating (1) with respect to t,

substituting from (2) and (3), and solving for the partial derivative of N with respect to t yields:

$$(4) \quad \frac{\partial N}{\partial t} = - \frac{wU_Y}{M} + \frac{(wN+V)}{(1-t)} \frac{\partial N}{\partial V}$$

which is analogous to the Slutsky equation. The first term, the substitution effect, is positive since U_Y is positive and M is negative. Hence, the direction of the home production response to taxation depends on the sign and magnitude of the income effect, which, in turn, depends on the sign of the partial derivative of N with respect to V. If home production increases in response to an increase in non-work income, the income effect is positive and the effect of an increase in the marginal rate of taxation is to increase home production activity. If home production decreases in response to an increase in non-work income, the substitution and income effects work in opposite directions and the effect of taxation on home production is theoretically indeterminate. The empirical model described in the next section attempts to resolve this indeterminacy and assess the impact of taxation on time spent in home production.

II. The Empirical Model and Its Estimation

The theoretical model of the previous section suggests that hours of home production will depend on the after-tax wage rate, the rate of return on home production, and the non-work income of the individual. The following function was selected to represent this relationship:

$$(5) \quad N = b_0 + b_1 w(1-t) + b_2 w'(1-t) + b_3 P(1-t) + b_4 Z + u$$

where the b's are constants, w' is the wage rate of the spouse, P is property income, Z is a set of productivity variables, and u is a stochastic disturbance.

The study utilizes a valuable source of data for studying home production behavior, the Michigan Income Dynamics data for 1976. These data are a cross-sectional sample of approximately 5,000 households and contain information on hours of housework and child care, as well as more conventional data on income, education, age, etc. They are especially interesting for the study of home production activity since wives as well as husbands were interviewed for the 1976 survey year.

From the husband's interview, data were available on his average weekly hours spent on housework--such as time spent cooking, cleaning, and other work around the house. The husband's average weekly hours of housework were multiplied by 52 to put them on an annual basis. From the wife's interview, data were available on her annual hours of housework, and her and her husband's annual hours of child care. Hours of housework and hours of child care were added together to give total hours of home production.

While wage rates were available in the data for the employed persons in the sample, the expected wage for those not in the labor force had to be imputed. A technique developed by Heckman (1976, 1979) was used in order to obtain consistent estimates of the wage equation.

As a first step in adapting the Heckman technique to our problem, probit analysis is used to estimate the probability that an individual participates in the labor force:

$$p(LFP) = F(\gamma_1 X_1, \gamma_2 X_2)$$

where X_1 is a set of explanatory variables for labor force participation, X_2 is a set of explanatory variables for the expected wage, and the γ are parameters of the probit analysis.

The parameters of the probit estimation are then used to estimate λ, the inverse of the Mill's ratio, and the estimated value of λ is used as a regressor in the wage equation:

$$w = \beta_1 X_2 + \beta_2 \lambda + v$$

where v is a stochastic disturbance. The wage equation is then estimated using ordinary least squares on the labor force participants in the sample. Heckman has shown that the estimates of β_1 using this technique are consistent.

The wage equation was then used to impute an expected disposable wage to all wives in the sample. In the few cases where the husband's wage was not available in the data, the observation was discarded from the sample.

In order to put the wages on an after-tax basis, they were multiplied by one minus the marginal rate of tax which was available in the data. In order that the marginal tax rate might be treated as an exogenous variable, it was assumed that the tax function is linear in the vicinity of observed hours of work. A similar approach was taken by Wales and Woodland (1977) who point out that the approach is justified by the fact that the U.S. tax system contains rather wide brackets. They feel that "for most households the misspecification due to assuming the budget constraint is linear about the observed point will not be great."[1]

Property income was computed as a residual by subtracting the wage income of the husband and wife from total family income. The variable was then multiplied by one minus the marginal tax rate to put it on an

after-tax basis. No attempt was made to impute non-money income or capital gains.

The other explanatory variables included the number and ages of children in the family, age, and education. Four variables were constructed to account for the number of children in various age categories: one to two years, three to five years, six to thirteen years, and fourteen to seventeen years. Age was measured in years and education as the number of years of school completed.

The model was estimated for both husbands and wives using ordinary least squares on a subset of the sample. Only married households not on welfare and with non-negative property income were selected. The subsample consisted of 1523 observations. The results of the estimation are reported in the next section.

III. The Results

The first step in the estimation was to estimate the probability of the wife's labor force participation as a function of two sets of explanatory variables: one for labor force participation and the other for the expected wage. The results of the probit estimation appear in Table 1. The three variables explaining labor force participation are the husband's disposable wage rate, property income after tax, and the total number of children in the family. All three have the expected influence on labor force participation. The other three variables, education, experience, and experience squared, explain the expected wage. The experience variable was computed by subtracting the number of years of education plus five from age.

TABLE 1

Probit Estimation of the Probability of Labor Force Participation of Married Women

Characteristic	Coefficient
Constant	.111
Husband's disposable wage	-.123[a]
Property income after tax	-.00004[a]
Education	.081[a]
Number of Children	-.158[a]
Experience	.039[a]
Experience squared	-.001[a]
-2 x Log Likelihood Ratio	.135 E+03
Number of Iterations	4

[a]Coefficient significant at the .95 confidence level.

The parameters of the probit estimation were then used to calculate λ which was used to adjust for bias in the wage equation. The results of the ordinary least squares estimation of the wage equation appear in Table 2. Together with λ, education, experience, and experience squared were the regressors in this equation. This equation was then used to impute a disposable wage to all women in the sample.

Table 3 shows the results of estimating equation (5) for married women. Hours of housework, hours of child care, and total hours of home production are the dependent variables. Examination of the coefficients of determination, R^2, which appear near the bottom of the table, shows reasonably good fits for cross-sectional data.

An increase in the wife's disposable wage leads her to reduce hours of housework but increase hours of child care for a decrease in total hours of home production. Increases in the husband's disposable wage lead the wife to increase hours of housework but has no significant effect on hours of child care or total hours of home production. An increase in property income after tax leads to an increase in hours of housework and to total hours of home production but has no significant effect on hours of child care.

The number and ages of children are, as expected, important determiners of time spent on housework and child care. Younger children have a more important influence on home production activity than do older children. High school age children have a small positive impact on hours of housework but do not significantly influence child care time.

In order to examine racial differences in behavior, the home production equation was estimated separately for black and non-black married

TABLE 2

Ordinary Least Squares Estimation of the Disposable Wage Rate of Employed Married Women

Characteristic	Coefficient
Constant	-.974[a]
Education	.281[a]
Experience	.017
Experience squared	-.002
Probit λ	.110
R^2	.107
F	28.7

[a]Coefficient significant at the .95 confidence level.

TABLE 3

Influences on Hours Spent in Housework, Child care, and Home Production by Married Women

Characteristic	Hours of: Housework	Child care	Home Production
Constant	1577[a]	43	1620[a]
Wife's disposable wage	-191.3[a]	65.9[b]	-125.3[a]
Husband's disposable wage	28.2[a]	-15.1	13.0
Property income after tax	.029[a]	-.010	.018[b]
Children 1-2 years	266[a]	821[a]	1088[a]
Children 3-5 years	241[a]	375[a]	616[a]
Children 6-13 years	150[a]	147[a]	297[a]
Children 14-17 years	84[a]	-21	63
R^2	.121	.247	.283
F	29.8	71.2	85.5

[a]Coefficient significant at the .95 confidence level.

[b]Coefficient significant at the .90 confidence level.

women. The results appear in Table 4. An F-test allowed us to reject the hypothesis that the parameters of the regression equations for each racial group are equal.[2]

Two interesting differences appear in the estimations by race. One is the finding that hours of home production activity by black wives tend to be wage insensitive while non-black wives have a strong negative response to increases in their disposable wage rate. The other is the differential influence of the number and ages of children on the home production behavior of wives. Children at all age levels have a greater impact on the home production activity of non-black wives than of black wives. However, both black and non-black wives spend more time in home production as the number of children increases. Further, the magnitude of the impact declines as the children's ages increase.

The home production function was also estimated separately for black and non-black husbands, with the results appearing in Table 5.[3] Overall husbands tend to be insensitive to changes in their own wages. Black husbands, however, increase their hours of home production in response to increases in their wife's disposable wage. Increases in property income lead to significant reductions in the home production activity of non-black husbands but do not influence blacks' behavior. The results for husbands also show that, like wives, increases in home production activity are associated with an increase in the number of children, younger children having a greater impact than older children. Finally, the impact of children on time spent in home production is greater for non-blacks than for blacks.

TABLE 4

Influences on Hours Spent in Home Production by Married Women by Race

Characteristic	Hours of Home Production	
	Blacks	Nonblacks
Constant	1522[a]	1794[a]
Wife's disposable wage	-24.5	-191.0[a]
Husband's disposable wage	-25.6	4.5
Property income after tax	.032	.015
Children 1-2 years	575[a]	1282[a]
Children 3-5 years	377[a]	713[a]
Children 6-13 years	176[a]	368[a]
Children 14-17 years	-24	123[a]
R^2	.126	.357
F	6.7	93.8

[a]Coefficient significant at the .95 confidence level.
[b]Coefficient significant at the .90 confidence level.

TABLE 5

Influences on Hours Spent in Home Production by Married Men by Race

Characteristic	Hours of Home Production		
	Blacks	Nonblacks	All
Constant	223	229[a]	240[a]
Wife's disposable wage	128.8[a]	32.2	48.9[a]
Husband's disposable wage	-18.0	-2.6	-7.7
Property income after tax	-.014	-.015[a]	-.016[a]
Children 1-2 years	101[b]	302[a]	254[a]
Children 3-5 years	205[a]	176[a]	195[a]
Children 6-13 years	42	93[a]	81[a]
Children 14-17 years	-48	-1	-10
R^2	.095	.145	.128
F	4.9	28.7	31.9

[a]Coefficient significant at the .95 confidence level.

[b]Coefficient significant at the .90 confidence level.

In order to assess the importance of the tax effect, tax elasticities showing the expected percentage change in hours of home production for a one percent increase in the marginal tax rate were computed by sex and race.[4] These are presented in Table 6. A positive elasticity implies that an increase in the marginal rate of tax is expected to have a positive influence on hours of home production. The results show that both black and non-black wives respond to increases in the tax rate by increasing time spent in home production. The effect is substantially larger for non-black women. On the other hand, both black and non-black married men respond to tax increases by reducing their hours of home production, the effect being greater for black men.

IV. Implications for Tax Policy

The case for the taxation of home production (or, alternatively, allowance for expense) is usually argued on equity grounds. As Musgrave (1959) points out, failure to tax the imputed value of non-market time leads to unequal treatment of people in essentially equal positions.[5] Two families with equal full incomes (money income plus imputed home production income) do not pay equal taxes if imputed income is untaxed. Further, the distribution of taxes over income classes may be distorted by failure to tax imputed income.

However, based on the findings of this study, a case for the taxation of home production can also be made on efficiency grounds. This study showed that taxation distorts the home production decisions of households, encouraging the home production activity of wives and discouraging that of husbands. This distortion contributes to the excess burden or deadweight loss of taxation.

TABLE 6

Tax Elasticities by Race and Sex

Group	Tax Elasticity
Black married women	.018
Nonblack married women	.080
All married women	.040
Black married men	-.110
Nonblack married men	-.055
All married men	-.050

The direct taxation of home production activity under the income tax is probably infeasible.[6] Enforcement difficulties and problems of delimiting home production from leisure activities (raising a flower garden vs. raising a vegetable garden, for example) would have to be overcome. Furthermore, the taxation of home production could cause inequity for families with low money resources for meeting their tax liability. In light of these difficulties, it would appear that any adjustment in the tax system must allow tax deductions or credits for the expenses of hiring housework by those who work outside the home or permit an earned income allowance for two-job couples.

Since 1977, the U.S. tax system allowed two-earner families a 20 percent nonrefundable tax credit on expenditures up to $2,000 for the care of a dependent while at work and up to $4,000 for two or more dependents. Prior to 1977, all married couples with both the husband and wife employed and having incomes less than $6,000 were able to deduct up to $600 for the cost of the care of one child while they were at work and up to $900 for two or more children.

An alternative to the child care deduction or credit for working families is an earned income allowance for two-earner families. Break and Pechman (1975) suggest that working couples might be given a special deduction of 25 percent of the earnings of the spouse with the lower earnings, up to a maximum of $2,500; or they might be given a tax credit of 10 percent of the earnings of the spouse with the lower earnings, up to a maximum of $1,000.[7] The U.S. Treasury in its recent study of U.S. tax reform suggests that only 75 percent of the wage income of secondary

earners be included in family income, with this exclusion limited to the first $10,000 of earnings. In addition, the Treasury study advocates a child care deduction equal to half the actual cost of child care up to a limit of either $5,000 or the taxable earnings of the secondary worker, which ever is smaller.[8]

V. Conclusions

The purpose of this study was to explore the impact of taxation on the home production behavior of households. Using data from the Michigan Survey of Income Dynamics, a home production equation was estimated for husbands and wives. The results of the study suggest that one effect of taxation is to encourage the home production activity of wives and discourage home production by husbands. The estimation results also show that we can expect a larger tax response from non-black wives and from black husbands.

Several important qualifications are in order. One involves the assumption that the disposable wage rate is independent of hours worked. If these two variables are not independent, then a simultaneous equation problem arises. The problem of dependence is a special concern in this study because the marginal tax rate in a progressive tax system is a function of income, which, in turn, depends on hours worked. It is hoped that using a bracket tax system with rather wide brackets minimized the seriousness of this problem.

One might also question whether or not the disposable wage rate variable should be decomposed into a gross wage and a tax variable. This was done in a study by Rosen (1976) in order to measure the strength of

"tax illusion" among married women. Rosen found no evidence of tax illusion with respect to the work decision of married women. Hence, no attempt was made in this study to decompose the disposable wage rate variable.

Finally, an interdependence between the disposable wage rates, after-tax property income, and the number of children may cause an estimation problem. As the number of tax exemptions increases with the number of children, taxable income decreases and the marginal tax rate decreases. This, in turn, affects the disposable wage rates and after-tax income. This interdependence could cause complications in the estimation due to multi-collinearity among the explanatory variables. An examination of the correlation coefficients, however, suggests this is not a serious problem. The interdependence could also cause a problem in measuring the impact of an additional child on hours of work. The addition of a child not only has an effect on time allocation equal to the coefficient of the children variable, it also has an effect on time allocation via the influences of the marginal tax rate on the disposable wage rates and on after-tax property income. This indirect effect was disregarded in the present study but suggests the need for future research.

Footnotes

[1]Wales and Woodland (1977), p. 118.

[2]See Kmenta (1971), p. 373.

[3]An F-test led to a rejection of the hypothesis the parameters of the black and non-black regression equations are equal.

[4]The tax elasticities were computed according to the following formula:

$$\varepsilon = \frac{\partial N}{\partial t} \cdot \frac{t}{N} = (-b_1 w - b_2 w' - b_3 P) \cdot t \cdot N^{-1}$$

where the variables were evaluated at their means.

[5]See Musgrave (1959), p. 170.

[6]See Due and Friedlaender (1977), pp. 225-6, for a discussion of the important problems in taxing self-produced goods.

[7]Break and Peckman (1975), p. 26.

[8]U.S. Treasury, Blueprints for Basic Tax Reform (1977), p. 105.

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